Chapter 8
Corrosion Control

8-1. General Considerations

Corrosion damage will occur over time and can seriously impair structural and operational capacity of tainter gates. To minimize future structural problems and high maintenance and rehabilitation costs, resistance to corrosion must be considered in the design process. Tainter gates are vulnerable primarily to localized corrosion (i.e., crevice corrosion or pitting corrosion), general atmospheric corrosion, or mechanically assisted corrosion. Brief theoretical discussions on corrosion are presented in EM 1110-2-3400 and CASE (1993). Prudent design and maintenance practices can minimize the occurrence of these types of corrosion. Corrosion in tainter gates is best controlled by application of protective coatings but can be minimized with the proper selection of materials and proper design of details. Cathodic protection systems can be applied but are not very common on tainter gates. The selection of corrosion protection alternatives is highly dependent on the particular environment in which the gate will function.

8-2. Material Selection and Coating Systems

a. Material selection. Except for unusual cases, there are few options in selecting materials for the construction of tainter gates. Structural members on tainter gates should be constructed of all-purpose carbon grade steel (such as ASTM A36) or high-strength, low-alloy steel (such as ASTM A572, grade 50). Steel that is available today often has a dual certification. Weathering steel (atmospheric corrosion resistant, high-strength low-alloy steel, ASTM A242 or ASTM A588) that is uncoated is not recommended for use in construction of tainter gates or trunnion girders. Coated weathering steel might be warranted in certain conditions. Protective coatings applied to weathering steel typically provide longer corrosion life than those applied to other steels. The initial cost of weathering steel is generally higher than that of other high-strength, low-alloy steels, but the additional cost of coated weathering steel may be offset by the reduced maintenance costs. Embedded items that are difficult to maintain (including the sill plate and side-seal rubbing plate) should be constructed of stainless steel, and trunnion bushings are generally bronze. All carbon grade or high-strength, low-alloy steel should be coated. Where dissimilar metals are in contact, rubber gaskets or equivalent insulators should separate them. Generally, this is not necessary for stainless steel bolts, because the area of contact between the bolt and structural steel is very small.

b. Coating systems. Application of coating systems is the primary method of corrosion protection for tainter gates. For normal atmospheric exposure, alkyd enamel and aluminum-based systems provide adequate protection. For gates subject to frequent wetting and fresh water immersion, vinyl systems generally perform the best. For salt water and brackish water environments, coal tar epoxy systems are most effective. In general, vinyl systems are the most appropriate for tainter gates. Metalizing should be considered for conditions that are predicted to include extreme abrasion conditions due to ice and debris or where there are stringent regulations governing the use of volatile organic compounds (VOC). EM 1110-2-3400, CWGS 09940, and CWGS 05036 provide detailed information on selection, application, and specifications of coating systems.

8-3. Cathodic Protection

For gates or portions of gates that are usually submerged, cathodic protection should be considered to supplement the paint coatings. Since corrosion is a continuing process of removing electrons from the steel, cathodic protection introduces a slow current to counteract this effect. This essentially causes all parts of the structure to be cathodic. Cathodic protection is achieved by applying a direct current to the structure from

some outside source. The direct current can be invoked either by impressed current or sacrificial anodes attached to the gate. CWGS-16643, provides guidance on impressed current cathodic protection systems for miter gates. Many of the same basic principles can be applied to tainter gates.

8-4. Design Details

Crevices, areas where ponding water may accumulate, locations where dissimilar metals are in contact, and areas subject to erosion are all susceptible to corrosion. Structural detailing has a significant impact on the structure's susceptibility to corrosion. Structures should be detailed to avoid conditions that contribute to corrosion. The following items should be considered in the design process.

a. Structural members should be detailed such that all exposed portions of the structure can be painted properly. Break sharp corners or edges to allow paint to adhere properly.

b. Drain holes should be provided to prevent entrapment of water. Extra large drain holes located in areas where the silt may be trapped (i.e., where member connections form open-ended chambers) are appropriate.

c. Lap joints should be avoided, but where used, the joint should be welded so that water can not be trapped between the connected plates.

d. Weld ends, slag, weld splatter, or any other deposits should be ground from the steel. These are areas that form crevices and can trap water. Use continuous welds.

e. Where dissimilar metals are in contact (generally carbon steel and either stainless steel or bronze), an electric insulator should be provided between the two metals. Large cathode (stainless steel)-to-anode (carbon steel) area ratios should be avoided. Surfaces of both metals should be painted. If only the anode metal is painted and there is a small defect in the coating, the cathode-to-anode area ratio will be very large and rapid corrosion can occur.

f. Where possible, welds should be used in lieu of bolts, considering the effect on fracture resistance. In general, welded connections are more resistant to corrosion than bolted connections. In bolted connections, small volumes of water can be trapped under fasteners and between plies that are not sealed.

g. In some cases, specifying a uniform increase in member component thickness provides a structure with increased resistance to corrosion damage. However, this is not recommended as a general practice. This is not effective for localized corrosion, the total structural cost is increased, and the increase in member resistance to tension, compression, and bending effects is not uniform.

h. If a protective coating must be applied, steel must generally be sandblasted prior to painting, and accessibility for sandblasting should be considered. A sandblasting hose generally cannot be bent.